

González, N. & Muñoz, M.F. (2006): "Causal ambiguity of technological competences, human resource practises and competitive advantage", International Journal of Technology Management, vol. 35, (308-328).

CAUSAL AMBIGUITY OF TECHNOLOGICAL COMPETENCIES, HUMAN RESOURCE PRACTICES AND COMPETITIVE ADVANTAGE

Nuria González-Álvarez
Associate Professor of Management
Universidad de León
Área de Organización de Empresas
Campus de Vegazana s/n
24071- León
Tel. 987291714- Fax. 987291750
e-mail: ddenga@unileon.es

María Felisa Muñoz-Doyague
Associate Professor of Management
Universidad de León
Área de Organización de Empresas
Campus de Vegazana s/n
24071- León
Tel. 987291714- Fax. 987291750
e-mail: ddefmd@unileon.es

Biographical notes: Nuria González-Alvarez is an Associate Professor of Strategic Management at the University of Leon, Spain. She holds a Ph.D. in Management from that university. Her research interests concerns causal ambiguity of technology and inter and intra-firm transfer and imitation of technological competencies. María Felisa Muñoz-Doyague is an Associate Professor of Strategic Management at the University of León, Spain. She holds a Ph.D. in Management from that university. Her main research topic focuses on innovation, creativity and human resource management.

Abstract: Traditionally, it has been recognised that causal ambiguity of technology , by making it difficult for competitors to identify the technological competencies on which a particular firm bases its competitive advantage, represents an effective protection mechanism helping the firm to obtain superior performance. Recently, researchers have unearthed evidence that the effects of causal ambiguity also could be extend to the interior of the firm itself, hampering the diffusion of its own technological capabilities among its managers. In this case, the existence of causal ambiguity will have a negative impact on firm performance. The first aim of this article is to analyze both perspectives with the last end of establishing the net influence that causal ambiguity exerts on firm performance. The second one, to study how the high involvement human resources practices can help to solve this debate. With this in mind, a set of hypothesis is proposed and they will contrast using a sample of 258 Spanish manufacturing firms.

Keywords: Causal ambiguity, technology transfer, imitation, high involvement human resource practices.

1. Introduction

Technological innovation is crucial for firms to achieve a competitive advantage. Hence, the ability to effectively innovate is a central challenge for firms. Firms with superior technological competencies (i.e., the ability to apply scientific and technical knowledge to develop and improve products and processes) tend to be more innovative and thus perform at higher levels [1]. For technological competencies to yield a competitive advantage, they must be inimitable-costly or difficult for competitors to imitate. The construct of inimitability has received the most theoretical attention by scholars [2, 3] and the empirical assertions derived from this concept [4] are likely to be among the most important emanating from the resource-based view. This is due to its theoretical relationship with sustained competitive advantage [5]. Thus, protecting capabilities against imitation becomes a crucial aspect to take into account for achieving a sustainable competitive advantage [2, 6].

Technological competencies tend to be protected by various isolating mechanisms. There is empirical evidence about the degree of use and the effectiveness of some of these mechanisms. Thus, scholars have verified that firms tend to protect their technological competencies with legal protection measures (such as patents), using secrecy, adopting leadership strategies (lead time), by moving quickly down the learning curve, or controlling certain complementary resources (complementary sales/service, complementary manufacturing) [7].

Another barrier preventing valuable technology resources from imitation is the causal ambiguity of technology. In that sense, researchers have found a positive relation between the level of protection of the capabilities and the existence of causal ambiguity [2, 3, 8, 9, 10]. In the literature, the concept of causal ambiguity is used to refer to ‘a similar lack of understanding of the logical linkages between actions and outcomes, inputs and outputs, causes and effects that are related to technological or process know-how’ [11, p. 597]. As firms use their competencies, these reinforce each other and become more complex, which increases the level of causal ambiguity and hampers competitors’ attempts to understand and imitate them [12, p. 31]. Causal ambiguity derives from the very nature of the competencies, and from the essentially tacit character of the knowledge bound up in routines [13]. Indeed, the knowledge needed to carry out organisational routines tends to be tacit [14, 15, 16]. Even if the knowledge

bound up in each of the tasks making up a particular routine is explicit, the routine as a whole may be unknown to the majority of the participants, and hence be tacit [16].

It might in principle be thought that causal ambiguity, like the other isolating mechanisms, in protecting a firm's technological competencies from imitation by competitors will produce a positive effect on performance. However, some authors point out that causal ambiguity can also hamper managers' attempts to identify the technological capabilities on which their firm bases its competitive advantage [3, 17]. This ignorance will hinder the diffusion of routines inside the organisation [18] and in this case, causal ambiguity will have a negative effect on firm performance.

Which of these two effects will exert a bigger influence on firm performance? It has been noted that a technological capability, in order for it to be a source of competitive advantage, 'must not be so simple that it can be easily imitated, or so complex that it is difficult to use and control internally' [19, p. 9]. Causal ambiguity which hinders the comprehension of technological competencies affects both competitors and the managers of the firm itself. While the first effect will positively impact firm performance, the second will have a negative impact. The first aim of this paper is to analyse how the causal ambiguity around technological capabilities influences firm performance.

In this way, companies may achieve a sustainable competitive advantage if, on the one hand, they are able to make competitors perceive a high degree of causal ambiguity about technological competencies, which would ensure protection against imitation, and on the other, to make their own managers clearly identify the technological competencies that lead to such advantage, i.e. make them face a low level of causal ambiguity.

A possible way to obtain both effects may be through the use of human resources practices that help creating a work force that contribute to an increasingly fluent transfer of technological competencies within the firm and a hindered one outside. Among all HR practices which could be used, those known as 'high commitment' [20], 'high performance' [21], 'sophisticated' [22] or 'high involvement' [23, 24], that foster commitment and involvement of employees with their organisation, would be most suitable as literature shows evidence that such practices may help

increasing the degree of social complexity and causal ambiguity which would originate a competitive advantage by setting up barriers to imitation [25, 26].

Likewise, such practices, by encouraging, strengthening and maintaining employee motivation and commitment with regards to the firm may ease the intra-organisational transfer of firm competencies. In a work that it is focused on the transfer of best practices within units belonging to the same company, the role played by both the motivation of the source unit and that of the receiving unit in the success of the transfer has been emphasised [18]. Both motivations could be increased through the use of high commitment HR practices. So, knowledge transfer within firms is intimately connected to motivation [27].

In that sense, the second aim of this paper is to study the role played by high commitment human resource practices in the achievement of a competitive advantage, through the influence that such practices have on causal ambiguity.

2. Theoretical framework / effects of causal ambiguity

The concept of causal ambiguity was introduced by Lippman and Rumelt [27] to reflect the basic ambiguity concerning the nature of the connections between actions and outcomes. These authors describe this ambiguity in large and consolidated firms as follows: 'it is not easy to ascertain just why GM or IBM perform better than their competitors. The complexity of these firms defies easy analysis, so that the inputs responsible for their success may be often undervalued by the market for some time' [28]. In this way, causal ambiguity reflects the inability of economic agents to understand fully the causes of efficiency differences between firms [29].

Subsequently, the relations between firm competencies, barriers to imitation and sustainable competitive advantage have been analysed [3]. In this way, certain characteristics of firm competencies, such as tacitness, complexity and specificity, generate – in isolation or in combination – causal ambiguity, and therefore create barriers to imitation. Causal ambiguity has been seen to be the most efficient isolating mechanism that firms have to protect themselves from imitation by competitors [29, 30].

Traditionally, this reasoning has led scholars to assume that causal ambiguity is required for a sustainable competitive advantage, since it constitutes a barrier preventing

valuable technology resources from imitation. Under this perspective, by impeding imitation, causal ambiguity enhances performance [2, 3, 8, 10, 29, 30].

Recently, however, some researchers have questioned the direction of the influence of causal ambiguity on firm performance [17]. They have pointed out that causal ambiguity, by hindering the identification of the technological competencies which lead firms to achieve superior performances, also restricts the transfer of the same competencies inside the organisation [18] and may block factor mobility [3, pp. 90-91, 8, p. 420]. In this way, causal ambiguity will impede the internal diffusion of knowledge and reduce its level of creation inside the organisation [31]. Hence, in this case, causal ambiguity exerts an adverse influence on performance.

Thus, at present there is a debate in the literature about the influence exerted by causal ambiguity on firm performance, since although on the one hand this variable slows the diffusion of superior practices and technologies across firms, on the other hand it impedes the creation of new knowledge within the firm [32].

In order to make a contribution to this debate, we distinguish between two types of causal ambiguity, depending on the economic agent which it affects.

First, *competitor ambiguity* refers to the causal ambiguity that a firm's competitors face when they attempt to identify the technological competencies that have helped the firm to achieve its superior competitive status in the market. Resource-based theorists (for example, [10]) suggest that causal ambiguity of technological knowledge is an important source of competitive advantages that keep firm's competencies from imitation. In practice, firms do sometimes bribe or hire away knowledgeable employees to learn about a competitor's superior capabilities [33]. These intelligence-gathering strategies will be less productive when employees can explain little about how a firm achieves superior performance [32]. On the basis of this reasoning, we advance the following hypothesis:

H1: Competitor ambiguity about firm technological competencies has a positive influence on firm performance

Second, *manager ambiguity* refers to the ambiguity perceived by the managers of a firm when attempting to determine the relation between their competencies and competitive advantage. As a firm extensively acquires explicit knowledge it reduces the level of causal ambiguity that protects its distinctive competence from imitation [32, p.

294]. Causal ambiguity impedes not only technology transfer across firms but also the creation of new knowledge within the firm [31].

Causal ambiguity has been found to be one of primary factors hindering best practice transfer within firm [18]. Firms incur high costs to transfer poorly understood technologies [34], which is consistent with the resource-based arguments, causal ambiguity also prevents a firm from learning from its own experience and from improving its performance over time [35]. Causal ambiguity hinders the internal diffusion of technological knowledge and decelerates the rate of knowledge creation within company. As Reed and DeFillipi, suggest, ‘where ambiguity is so great that managers do not understand intra firms causal relationships, or factor immobility exists, it may be impossible to utilize competencies for advantage’[3, pp. 90-91]. This idea leads to our second hypothesis:

H2: Manager ambiguity about firm technological competencies has a negative influence on firm performance

On the other hand, managers may discuss about what measures should be taken in order to have an influence on the effects that causal ambiguity of technology have on firm performance. In other words, should companies be aware of the fact that competitor ambiguity bars imitations and that manager ambiguity favours the internal transfer of firm technological competencies, they would be able to design mechanisms intended to simultaneously contribute to an ambiguity increase for some agents and a decrease for other.

High commitment or high involvement human resource practices, among such mechanism, may create a work force motivated and highly committed with the future of the organisation. Such practices include i.a. participation of employees, concern about their selection and training processes, performance appraisal and so on. Contrary to other more traditional practices that try to control employees for them to behave in a predetermined and accurately defined way [36], high involvement HR practices try to improve the capabilities of employees and to increase their motivation. There is quite a lot of literature on the relationship between such practices and turnover [20, 21, 24], productivity [21, 37, 38], financial returns [39], survival [40], and firm value [21, 41] or organisational performance [23, 42].

However, other researchers suggest that HR management systems have no direct influence on firm performance. Rather they influence firm resources, such as the human capital of the firm, or employee behaviours, and it is these resource and behaviours that ultimately lead to performance [43]. This statement assumes that could exist mediating variables between HR management practices and firm performance [44, p. 304]. Thus, we may say that HR practices have an influence on firm performance by creating a motivated work force, highly committed to the organisation. Furthermore, such influence may be unfolded into two effects. On the one hand the existence of a participative and motivated work force should bar competitors from identifying the technological competencies of the firm which lead to success which may help firm to obtain a sustainable competitive advantage through the increase of the degree of causal ambiguity perceived by rivals. Hypothesis H₃ supports this idea:

H3: The use by a firm of high involvement or high commitment human resource practices will increase the level of causal ambiguity about firm technological competencies perceived by its competitors

On the other hand, the managers of an organisation where high involvement HR practices are used will be more motivated to perform in a coordinated and goal oriented way [27]. Such motivation and involvement should result in a greater flow of knowledge within the company itself, which would help them to identify the competencies that have allowed for the success achieved on the market. This seems to show that high participation HR systems contribute to reduce the level of causal ambiguity faced by the managers of a company. Hypothesis H₄ expresses this idea:

H4: The use by a firm of high involvement or high commitment human resource practices will reduce level of causal ambiguity about firm technological competencies perceived by its managers

Subsequently, a conceptual model that includes these hypotheses is proposed as shown in Figure 1. Variables in the model are classified into three categories: the independent variable, mediating variables and dependent variable. Competitor ambiguity and manager ambiguity are treated as two mediators between high commitment human resource practices and firm performance as previous literature suggests [44].

INSERT FIGURE 1

3. Methodology

3.1 Data and sample

The sample of firms we have used to test our four hypotheses proposed comes from a directory of the largest Spanish firms [45]. The process of data selection and collection was as follows. First of all the sample was limited to manufacturing firms (with SIC code, between 20 and 39) of large and medium size (with a turnover above 20 million €in 1999). These criteria were applied to guarantee that the firms had developed a certain number of complex technological capabilities that might potentially cause problems of identification and comprehension on the part of both competitors and the firm's managers. Initially the sample contained 1967 firms meeting these criteria.

Secondly, as the information provided by the above-mentioned directory was not sufficient for the needs of our research, a questionnaire was sent to each of the 1967 firms. The questionnaire was addressed to the company's CEO considered to be the person most qualified to answer to the questions and with easiest access to the information required. We received 258 usable responses, which represent the 13,11 of the total.

3.2. Variable measures

To make the variables included in this research operative, subjective measures were mostly used supplied by respondents with regards to a number of indicators listed in the questionnaire. Appendix I includes the indicators used for measuring each variable implied in the research. We might mention that the indicators used to measure the competitor ambiguity were adapted from those used in previous investigations [11, 18], while the construct for manager ambiguity was especially built for this research. On the other hand, as a measure of high commitment human resource practices, twenty seven indicators, taken from recent publications dealing with the subject, were used [20, 21, 23, 38, 39, 42, 46, 47]

In order to summarise the data obtained for both types of causal ambiguity as well as for high commitment HR practices, two factor analyses were made, one on the indicators used to measure competitor and manager ambiguity of technology, and the other on the items relative to the HR variable. Both analyses were carried out following the principal components method and in order to obtain more easily interpretable results, we applied a factor rotation using the varimax method with Kaiser normalisation.

Table 1 shows the matrix of rotated components, the communalities, the initial eigenvalues, and the percentage of variance accounted for each component used for the case of the two types of causal ambiguity of technological competencies considered. As can be seen, the analysis resulted in two factors, each of which grouped the indicators corresponding to one type of ambiguity. Once these factors corresponding to the two types of ambiguity were detected, the factor scores of all the firms were noted for each factor.

INSERT TABLE 1 ABOUT HERE

In the same way, Table 2 shows the matrix of rotated components, the communalities, the initial eigenvalues, and the percentage of variance accounted for each component for the factorial analysis carried out on the indicators relative to high commitment HR practices. Based on this matrix, the following conclusions become available:

1. In the case of the first factor, it is easy to observe the significance of those indicators that refer to the degree of motivation of employees, to the amount of information shared by them and to the existence of an atmosphere of high cooperation and trust inside the firm. Thus, such variables would seem to imply the existence of a good climate in the firm, as employees are motivated and the environment is favourable. For these reasons, this factor was named CLIMATE.
2. The items referred to employee training plans carried out by the company and to concern about safety at work are outstanding in connection with the second factor. This would seem to indicate that the company takes care of the staff, especially as far as training is concerned. Therefore, this factor was named TRAINING.

INSERT TABLE 2 HERE

3. The third factor pays attention to items such as the ones referring to the existence of mechanisms and processes intended to increase the motivation of employees and to the existence of problem-solving groups and mechanisms that support new ideas (quality circles and suggestion systems). So, this factor seems to imply the existence of mechanisms that enhance innovation and creativity. Therefore, this factor was named INNOVATION SUPPORT.
4. The fourth factor is represented by the indicators referring to the reward policies used by the company and to results-based performance appraisal. It could refer to

the existence of a pay system especially based on results. For this reason, the factor has been named RESULTS-BASED COMPENSATION.

5. The fifth factor is only formed by items that refer to the selection processes applied by the company and is therefore named SELECTION.
6. In the case of factor number 6 it is easy to observe that significant items are those that refer to the existence of different wages for the same task and behaviour-based performance appraisal. It could refer to the existence of a pay system especially based on behaviour, which justifies a variety of salaries for the same job. Therefore, this factor has been named BEHAVIOUR-BASED COMPENSATION.
7. Finally, the seventh and last factor is formed by the indicators that refer to a broad design of jobs, i.e. that the jobs in the firm include a great variety of tasks and there is rotation of such jobs. This factor has been named JOB DESIGN.

Once we have completed the reduction of data referring to the indicators that measured the high commitment HR practices used by the company, the factor scores of all the firms were noted for each factor. Subsequently, following [23, 24, 48], we construct an index measure for high involvement human resource practices based on the factor scores noted for each firm. In that way, we create a new variable, that is, high involvement human resource practices, that adopted seven possible values. In order to distinguish whether a firm uses or not a particular factor of practices we compare each firm factor score to the average score of the same factor corresponding to the 258 firms of the sample. Since the average of each factor is 0 because they are resulted from a factor analysis, the new variable takes value 0 when the firm has not any factor score greater than 0 that means that the firm uses each high involvement practice in a less intensive way than the average of the firms. In the opposite side, the variable takes value 7 when the firm presents seven factor scores greater than 0. This indicates that that company uses each human resource practice related to each factor in a more intensive way than the average of the firms. So, a high score on the human practices measure indicates relatively intensive use and investment in high involvement human resource practices. On the other hand, lower scores on this measure indicate less intensive use of high involvement human resource practices.

The use of a single high involvement human resource practices index is supported by arguments made by some authors [49] who agree with the extent practice

in the empirical literature that an index derived from prior empirical work is the more appropriate measure of the human resource system since a single index reflects the notion of a single human resource management system as a strategic asset.

With regards firm performance, this was made operative using two measures. First, we use return on assets (ROA) as an objective measure of success. A rich and long tradition operationalizes firm performance based on financial data from secondary sources, such as return on assets, return on invested capital and return on sales [50, 51]. ROA presented several advantages as a measure of performance. This measure provides superior relative year-to-year stability against other measures [52] and it continues to be accepted in the current literature [53, 54].

Moreover we also use a multidimensional subjective measure to assess organizational performance. This measure included economic-financial as well as socio-organisational indicators, since only considering these in combination allows us to evaluate the success of an organisation [55]. Consequently, we built two scales of items [56]. The objective of the first scale was for the managers to evaluate the importance of the indicators proposed. With the second scale, the aim was for the managers to express their level of satisfaction with respect to their expectations about these indicators during the past trading year. Subsequently, we calculated a weighted average of the satisfaction scores of the managers on the nine indicators, with the importance scores acting as weights.

We use the financial data collected (ROA) to validate our perceptual measure [23]. The correlation between ROA and our perceptual performance scale is 0.13 ($p < 0.05$). That the correlation is statistically significant supports the general validity of the organizational performance measure, although the magnitude of the correlation is low. On the basis of this result, we decide to choose the subjective measure of performance since the rest of variables are measured in the same way.

In order to get unbiased estimators, we selected some control variables considered to be related to some of the variables in the study. Control variables were: the size of the firm (number of employees), the age of the firm, the period of time the CEO had been in the company and the sector to which the firm belonged.

The firm age was included as a control variable, since it has been considered in the literature as a measure of the ambiguity which competitors face [57]. Some authors

[57] believe that the longer the firm has been operating in the market, the better its competitors will know it, and hence the lower the degree of causal ambiguity these agents will face. Similarly, the same argument can be applied to CEO longevity, so that this variable was also included as a control variable.

Table 3 shows the means, standard deviations and correlations for all the dependent and independent variables considered in this study.

INSERT TABLE 3 HERE

4. Results

The analysis of the results obtained was made in three steps. The first one included the study of the influence of competitor ambiguity and manager ambiguity around technological competencies on firm performance according to the first aim of this paper. In the second step, in order to achieve our second objective, we analyse the high commitment HR practices as a determinant factor of both types of causal ambiguity. Finally, we test the role of competitor and manager ambiguity as mediating variables.

With regards to the first step, with the scores obtained from the factorial analysis relative to the modes of technological ambiguity, a regression analysis was made in order to explain the performance of the sample firms according to competitor and manager ambiguity, once the effects of size, age, CEO longevity and sector had been controlled. Table 4 shows the results of the hierarchical regression analysis carried out.

INSERT TABLE 4 HERE

In the first model, only control variables were included as independent variables. The second model added the ambiguity faced by the competitors. The third model added the ambiguity faced by the firm's managers as explicative variable to the above-mentioned variables.

Hypothesis 1 proposes that the ambiguity around firm technological competencies perceived by competitors of a firm will be positively related to the performance achieved by the firm. The significance and positive sign of the coefficient of this variable in both models 2 and 3 supports this hypothesis. Similarly, Hypothesis 2 predicts that the ambiguity faced by the firm's own managers is negatively related to the

firm's performance. The negative sign of the coefficient of this variable in Model 3, along with its significance, supports this hypothesis too.

Moreover, in the third model it can be seen that the parameter associated with the manager ambiguity is greater in absolute terms than that of the competitor ambiguity, which means that the effect exerted on firm performance by manager ambiguity is greater than that exerted by competitor ambiguity.

The second purpose of this paper is to analyse the influence of high commitment or high involvement human resource practices on competitor and manager ambiguity. Two groups of regression analyses were made, the target being the study of the influence of high human resource practices on each of the two types of causal ambiguity considered. In each of these analyses, one of the two modes of ambiguity was used as a dependent variable, and human resource variable as independent variable, in addition to control variables. Tables 5 and 6 show the results for both regression analyses.

Table 5 depicts the analysis carried out with competitor ambiguity as a dependent variable. The first model only includes the control variables, the second adds the HR practices index. Considering these results, we do not find empirical support for hypothesis H₃.

INSERT TABLE 5 HERE

Table 6 contains the analysis with manager ambiguity as a dependent variable and also includes a first model with the control variables as explanatory variables and a second one which adds the factors relative to human resource policy. Results allow asserting that high involvement or high commitment human resource practices have a negative influence on manager ambiguity as the parameter estimate for that variable is negative and significant, thus supporting hypothesis 4.

INSERT TABLE 6 HERE

Results suggest that manager ambiguity could mediate the effect of high involvement human resource practices on firm performance. A sequential procedure is adopted to test this mediating effect [58]. In the first step of the analysis, the dependent variable (i.e., firm performance) is regressed on high involvement human resource practices. This result is shown as model 1 in Table 7. In the second step, the mediator (i.e., manager ambiguity) is included in the model to assess whether it reduces the effect of high involvement human resources practices (model 2). Mediation occurs if the

effects of human resource practices on firm performance are reduced in the presence of the mediator and the overall fit is improved. Both of these conditions are acceptable, as is shown in Table 7.

INSERT TABLE 7 HERE

5. Conclusions

This research work has tried to analyse two questions relevant to the causal ambiguity notion. On the one hand, the influence of this variable on firm performance - literature contains a discussion on this subject matter-, and on the other, the influence of high commitment human resource practices on causal ambiguity. To this end, this paper makes a distinction between two types of causal ambiguity according to the economic agent it affects.

The results obtained allow, first of all, verifying that the causal ambiguity around technological competencies exerts a double-edged influence on the performances of large and medium-sized Spanish manufacturing firms. So, we have shown, on the one hand, that causal ambiguity constitutes one of the mechanisms which firms can use to defend their technology from the actions of their rivals, since we have tested that there is a positive association between the causal ambiguity faced by a firm's competitors and the performance of the firm. Thus, and as suggested by a number of previous studies, causal ambiguity protects firms from imitation, which contributes to the sustainability of their competitive advantage [2, 3, 8, 10, 17, 59].

On the other hand, we have demonstrated that the causal ambiguity which is faced by the firm's own managers has an adverse effect on firm performance. This finding is consistent with the authors that have questioned the effect of causal ambiguity on firm performance, arguing that although it impedes the diffusion of a firm's technological competencies outside the firm, thereby protecting them from the risk of imitation, it also blocks the transfer of these competencies inside the firm itself [17, 18, 31, 32].

Moreover, we have found that the effect on firm performance of manager ambiguity is greater than the effect of competitor ambiguity. This last finding contributes to resolving the debate in the literature, and is consistent with those studies stressing the need for knowledge to flow within organisations [18, 31, 60, 61, 62], since

manager ambiguity will only be reduced by the transfer of competencies within organisations. Only in this case will the firm be able to achieve superior performance.

On the other hand, referring to human resource practices as a factor that determines competitor and manager ambiguity around firm technological competencies, the way that some of these policies determine the presence of both types of ambiguity has been tested. In this sense, the use of human resource practices that foster a high commitment does not impact on firm performance directly. Its impact on firm performance indirectly through its impacts on manager ambiguity.

This last result is one of the newest contributions made by this paper since it adds some empirical evidence about the role played by causal ambiguity of technology as a mediator variable between human resource practices and firm performance as pointed out by some recent publications [43, 44, pp.304]

Finally, this research work presents some limitations. In this way, the measures of some of the variables used may be less precise than would be desirable, which may blunt some of the power of our tests on the four hypotheses proposed. Likewise, new factors that determine both competitor and manager ambiguity around firm technological competencies could have been found. For instance, competencies characteristics of a firm as tacitness, complexity and specificity can generate causal ambiguity [3]. Such limitations open new domains which could be the subject matter of research.

REFERENCES

- 1 Mcevely, S. K., Eisenhardt, K. M. and Prescott (2004), 'The global acquisition, leverage, and protection of technological competencies', *Strategic Management Journal*, Vol. 25, pp.713-722.
- 2 Dierickx, I. and Cool, K. (1989) 'Asset stock accumulation and sustainability of competitive advantage', *Management Science*, Vol. 35, pp.1504-1511.
- 3 Reed, R. and Defillipi, R. (1990) 'Causal ambiguity, barriers to imitation and sustainable competitive advantage', *Academy of Management Review*, Vol. 15, pp.88-102.
- 4 Barney, J.B. (2001), 'Is the resource-based 'view' a useful perspective for strategic management research? Yes', *Academy of Management Review*, Vol. 26, pp.41-56.
- 5 For more details about this relationship see De Carolis, D.M. (2003) 'Competencies and imitability in the pharmaceutical industry: an analysis of their relationship with firm performance', *Journal of Management*, Vol. 29, pp.27-50.
- 6 Spender, J. C. and Grant, R. (1996) 'Knowledge and the firm: overview', *Strategic Management Journal*, Vol. 17 (Winter Special Issue), pp.5-9.
- 7 Two of the most notable studies about protection mechanism against imitation are Levin, R.C., Klevorick, A.K., Nelson, R.S. and Winter, S.G. (1987) 'Appropriating the returns from industrial research and development', *Brooking Papers on Economic Activity*, Vol. 3, pp.783-820 and Cohen, W.M., Nelson R.N. and Walsh, J.P. (2000) 'Protecting their intellectual assets: appropriability conditions and why U. S. manufacturing firms patent (or not)', *National Bureau of Economic Research*, Working paper n° 7552.
- 8 Lippman, S.A. and Rumelt, R.P. (1982) 'Uncertain imitability: an analysis of interfirm differences in efficiency under competition', *Bell Journal of Economics*, Vol. 13, pp.418-438.
- 9 Barney, J.B. (1986a) 'Strategic factor markets: expectations, luck and business strategy', *Management Science*, Vol. 32, pp.1231-1241.
- 10 Barney, J. B. (1991) 'Firm resources and sustained competitive advantage', *Journal of Management*, Vol. 17, pp.99-120.
- 11 Simonin, B. (1999) 'Ambiguity and the process of knowledge transfer in strategic alliances', *Strategic Management Journal*, Vol. 20, pp.595-623.
- 12 Rumelt, R.P., Schendel, D.E. and Teece, D.J. (Eds.) (1994) *Fundamental Issues in Strategy*, Harvard Business School Press, Boston, MA.
- 13 Nelson, R.R. and Winter, S.G. (1982) *An evolutionary theory of economic change*, Harvard University Press, Cambridge, MA.
- 14 Itami, H. (1987) *Mobilizing invisible asset*, Harvard University Press, Cambridge, MA.
- 15 Rumelt, R. (1987) 'Theory, strategy and entrepreneurship', in D. Teece (Ed.) *The Competitive Challenge*, Ballinger Publishing, Cambridge, MA, pp.137-58.
- 16 Winter, S. G. (1987) 'Knowledge and competence as strategic assets', in D. Teece (Ed.) *The Competitive Challenge*. Ballinger Publishing, Cambridge, MA, pp.159-183.
- 17 King, A.W. and Zeithaml, C.P. (2001) 'Competences and the firm performance: examining the causal ambiguity paradox', *Strategic Management Journal*, Vol. 22, pp.75-99.

- 18 Szulanski, G. (1996) 'Exploring internal stickiness: impediments to the transfer of best practice within the firm', *Strategic Management Journal*, Vol. 17, pp.27-43.
- 19 Shoemaker, P.J.H. and Amit, R. (1994), 'Investment in strategic assets and firm-level perspectives', in P. Shrivastava, Huff, A. and Dutton, J. (Eds.) *Advances in Strategic Management*, JAI Press, Greenwich, Vol. 10A, pp.3-33.
- 20 Arthur, J. (1994) 'Effects of human resource systems on manufacturing performance and turnover', *Academy of Management Journal*, Vol. 37, pp.670-687.
- 21 Huselid, M.A. (1995) 'The impact of human resource management practices on turnover, productivity, and corporate financial performance', *Academy of Management Journal*, Vol. 38, pp.635-670.
- 22 Koch, M.J. and McGrath, R.G. (1996) 'Improving labour productivity: Human resource management policies do matter', *Strategic Management Journal*, Vol. 17, pp.335-354.
- 23 Bae, J. and Lawler, J.J. (2000) 'Organizational and HRM strategies in Korea: impact on firm performance in an emerging economy', *Academy of Management Journal*, Vol. 43, pp.502-517.
- 24 Guthrie, J.P. (2004) 'High involvement work practices, turnover and productivity: evidence from New Zealand', *Academy of Management Journal*, in press.
- 25 Lado, A.A. and Wilson, M.C. (1994) 'Human resource systems and sustained competitive advantage: a competency-based perspective', *Academy of Management Review*, Vol. 19, pp.699-727.
- 26 Snell, S.A., Yound, M.A. and Wright, P.M. (1996) 'Establishing a framework for research in strategic human resource management: Merging resource theory and organizational learning', in G. R. Ferris (Ed.): *Research in personnel and human resource management*, CT & London: JAI Press, Greenwich, Vol. 14, pp.61-90.
- 27 Osterloh, M. and Frey, B.S. (2000) 'Motivation, knowledge transfer and organizational forms', *Organization Science*, Vol. 11, No. 5, pp.538-550.
- 28 Lippman and Rumelt [8] take this argument from Demsetz, H. (1972) 'Industry structure, market rivalry and public policy', *Journal of Law and Economics*, Vol. 16, pp.1-9.
- 29 Rumelt, R. (1984) 'Toward a strategic theory of firm', in R. Lamb (Ed.) *Competitive strategic management*, Prentice-Hall, Englewood Cliffs, pp.556-570.
- 30 Mahoney, J.T. and Pandian, J.R. (1992) 'The resource-based view within the conversation of strategic management', *Strategic Management Journal*, Vol. 13, pp.363-380.
- 31 Lin, B.W. (2003) 'Technology transfer as technological learning: a source of competitive advantage for firms with limited R&D resources', *R&D Management*, Vol. 33, pp.327-341.
- 32 Mcevily, S.K., Das, S. and McCabe, K. (2000) 'Avoiding competence substitution through knowledge sharing', *Academy of Management Review*, Vol. 25, pp.294-311.
- 33 For further details about this topic see Besanko, D., Dranove, D. and Shanley, M. (2000), *Economics of strategy*, 2nd ed., John, New York .
- 34 Teece, D.J. (1976) *The multinational corporation and resource cost of international technology transfer*, Ballinger, MA.
- 35 For example, see Huber, G.P. (1991) 'Organizational learning: the contributing processes and the literatures', *Organization Science*, Vol. 2, pp.88-115.

- 36 Walton, R. (1985) 'From 'control' to commitment in the Workplace', *Harvard Business Review*, Vol. 73, No. 2, pp.77-84.
- 37 Ichniowski, C., Shaw, K. and Prennushi, G. (1997) 'The effects of human resource management practices on productivity: a study of steel finishing lines', *American Economic Review*, Vol. 87, pp.291-313.
- 38 Macduffie, J.P. (1995) 'Human resource bundles and manufacturing: performance: Organizational logic and flexible production systems in the world auto industry', *Industrial and Labor Relations Review*, Vol. 48, pp.197-221.
- 39 Delery, J.E. and Doty, D.H. (1996) 'Modes of theorizing in strategic human resource management: tests of universalistic, contingency and configurational performance predictions', *Academy of Management Journal*, Vol. 39, pp.802-835.
- 40 Welbourne, T.M. and Andrews, A.O. (1996) 'Predicting the performance of initial public offerings: should human resource management be in the equation?', *Academy of Management Journal*, Vol. 39, pp.891-919.
- 41 Huselid, M.A. and Becker, B.E. (1997) 'The impact of high performance work systems, implementation effectiveness, and alignment with strategy on shareholder wealth', Unpublished paper. New Brunswick, NJ: Rutgers University
- 42 Delaney, J.T. and Huselid, M.A. (1996) 'The impact of human resource management practices on perceptions of organizational performance', *Academy of Management Journal*, Vol. 39, pp.949-969.
- 43 Wright, P.M., McMahan, G.C. and McWilliams, A. (1994) 'Human resources and sustained competitive advantage: a resource-based perspective', *International Journal of Human Resource Management*, Vol. 5, pp.301-326.
- 44 Delery, J.E. (1998) 'Issues of fit in strategic human resource management: implications for research', *Human Resource Management Review*, Vol. 8, No. 3, pp.289-313.
- 45 Duns and Bradstreet España (2001), *Duns 50.000 Principales Empresas Españolas*, Madrid.
- 46 Cutcher-Gershenfeld, J.C. (1991) 'The impact on economic performance of a transformation in workplace relations', *Industrial and Labour Relations Review*, Vol. 44, pp.241-260.
- 47 Arthur, J. (1992) 'The link between business strategy and industrial relations systems in American steel minimills', *Industrial and Labour Relations Review*, Vol. 45, pp.488-506.
- 48 Richard, O. C. and Johnson, N. B. (2001) 'Strategic human resource management effectiveness and firm performance', *International Journal of Human Resource Management*, Vol. 12, No. 2, pp.299-310.
- 49 Becker, B.E. and Huselid, M.A. (1998) 'High performance work systems and firm performance: A synthesis of research and managerial implications', *Research in Personnel and Human Resources Journal*, Vol. 16, No. 1, pp.53-101.
- 50 For example, see Bettis, R.A. (1981) 'Performance differences in related and unrelated diversified firms', *Strategic Management Journal*, Vol. 17 (Winter Special Issue), pp.123-135.
- 51 For example, see Christensen, H.K. and Montgomery, C.A. (1981) 'Corporate economic performance: diversification strategy versus market structure', *Strategic Management Journal*, Vol. 2, pp.327-343.

- 52 Hill, C.W.L., Hitt, M.A. and Hoskisson, R.E. (1992) 'Cooperative versus competitive structures in related and unrelated diversified firms', *Organization Science*, Vol. 3, No 4, pp.501-521.
- 53 Wiersema, M.F., and Bantel, K.A (1993) 'Top management team turnover as an adaptation mechanism: the role of the environment', *Strategic Management Journal*, Vol. 14, pp.485-504.
- 54 Balinga, B.R., Moyer, R.CH. and Rao, R.S. (1996) 'CEO duality and firm performance: what's the fuss?', *Strategic Management Journal*, Vol. 17, pp.41-43.
- 55 Robbins, S. P. (1990) *Organization theory: sctructure, designs and applications*, 3rd Ed, Prentice Hall International Editions, Englewood Cliffs.
- 56 Following Naman, J.L. and Slevin, D.P. (1993) 'Entrepreneurship and the concept of fit: a model and empirical tests', *Strategic Management Journal*, Vol. 14, pp.137-153.
- 57 Mosakowski, E. (1997) 'Strategy making under causal ambiguity: conceptual issues and empirical evidence', *Organization Science*, Vol. 8, pp.414-442.
- 58 This procedure is recommended by Baron, R.M. and Kenny, D.A. (1986) 'The moderator/mediator variable distinction in social psychological research: conceptual, strategic and statistical considerations', *Journal of Personality and Social Psychology*, Vol. 51, pp.1173-1182.
- 59 Barney, J.B. (1986b) 'Organizational culture: can it be a source of sustained competitive advantage?', *Academy of Management Review*, Vol. 11, pp.656-665.
- 60 O'Dell, C. and Grayson, C. (1998) 'If only we knew what we know: identification and transfer of internal best practices', *California Management Review*, Vol. 40, No 3, pp.154-174.
- 61 Hansen, M.T. (1999) 'The search- transfer problem: the role of weak ties in sharing knowledge across organization subunits', *Administrative Science Quartely*, Vol. 44, pp.82-111.
- 62 Argote, L. and Ingram, P. (2000) 'Knowledge transfer in organizations: a basis for competitive advantage in firms', *Organizational Behaviour and Human Decision Processes*, Vol. 82, pp.150-169.

APPENDIX 1
Items included in questionnaire

VARIABLE	MEASURES				
<p style="text-align: center;">Manager ambiguity</p> <p style="text-align: center;">$\alpha=0.79$</p>	<ul style="list-style-type: none"> • Top and middle managers in our firm know what technological resources lead to the firm to achieve a superior performance to our competitors (MA1) • Top and middle managers in our firm can determine the causes of failures of our firm (MA2) • Top and middle managers in our firm know the technological strategy adopted by the firm (MA3) • Top and middle managers in our firm are generally informed about any change in the technological strategy (MA4) • The majority of the top and middle managers in our firm know when a new product is going to be develop and launched (MA5) • Our firm has the policy of explaining to top and middle managers the causes of rises or falls in profits (MA7) 				
<p style="text-align: center;">Competitor ambiguity</p> <p style="text-align: center;">$\alpha=0.66$</p>	<ul style="list-style-type: none"> • Our competitors are unable to imitate immediately the knowledge and technology used by our firm (CA1) • Our competitors do not know the keys of our success (CA2) • Our competitors do not know the causes of rises or falls in the profits of our firm (CA3) • Our competitors find it difficult to establish the specific technological actions carried out by our firm to achieve a superior performance (CA4) 				
<p style="text-align: center;">Firm performance</p>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%; vertical-align: top;">FINANCIAL MEASURE</td> <td> <ul style="list-style-type: none"> • Return on assets (ROA) </td> </tr> <tr> <td style="vertical-align: top;">SUBJETIVE MEASURE</td> <td> <ul style="list-style-type: none"> • Operating profit • Sales growth • Growth in profits • Market share • Return on investment • New product development • Market development • Absence of conflict in firm • Productivity </td> </tr> </table>	FINANCIAL MEASURE	<ul style="list-style-type: none"> • Return on assets (ROA) 	SUBJETIVE MEASURE	<ul style="list-style-type: none"> • Operating profit • Sales growth • Growth in profits • Market share • Return on investment • New product development • Market development • Absence of conflict in firm • Productivity
FINANCIAL MEASURE	<ul style="list-style-type: none"> • Return on assets (ROA) 				
SUBJETIVE MEASURE	<ul style="list-style-type: none"> • Operating profit • Sales growth • Growth in profits • Market share • Return on investment • New product development • Market development • Absence of conflict in firm • Productivity 				

APPENDIX 1
Items included in questionnaire (continued)

VARIABLE	MEASURES
<p>Human Resource Practices $\alpha=0.90$</p>	<ul style="list-style-type: none"> • Our firm works hard to find the adequate people for each job (SEL1) • Our firm devotes quite a lot of time to staff selection processes (SEL2) • Our firm only selects employees having the necessary qualifications for the job (SEL3) • Our selection processes take into account the problem solution skills of each candidate (SEL4) • Our firm applies exhaustive processes to personnel training (TRN1) • Some training activities in our firm are addressed to employees that require technical skills (TRN2) • Some training activities in our firm are addressed to employees that need certain skills required for the solution of problems (TRN3) • Our employees assimilate the specific training we give them (TRN4) • In our firm, employee compensation is based on their skills (COMP1) • Our firm applies compensation systems based on individual performance (COMP2) • Our firms grants incentives based on group productivity (COMP3) • Salaries paid by our firm are high if compared with those paid by our competitors (COMP4) • Within the same level of work there is a wide range of salaries (COMP5) • The performance of our employees is assessed according to results (APPR1) • The performance of our employees is assessed according to their behaviour (APPR2) • Jobs in our firm require a great variety of skills and capabilities (JDSN1) • The rate of rotation of jobs in our firm is high (JDSN2) • Employees are allowed a certain degree of autonomy at work (MOTI1) • Our employees take the performance of their task as a personal challenge (MOTI2) • Our employees are highly motivated (MOTI3) • Our firm has available mechanisms and procedures planned for an increase of employee motivation (MOTI4) • Our employees share information (OTHS1) • In our firm, there are groups of people whose task is to help solving problems (OTHS2) • Quality circles intended to evaluate new ideas are used in our firm (OTHS3) • Our employees have available some mechanisms -such as mail-boxes for suggestions- allowing them to contribute new ideas and development (OTHS4) • A high cooperation and confidence climate is existing in our firm (OTHS5) • Our firm is careful about conditions and safety at work. (OTHS6)

FIGURE 1
Conceptual Framework

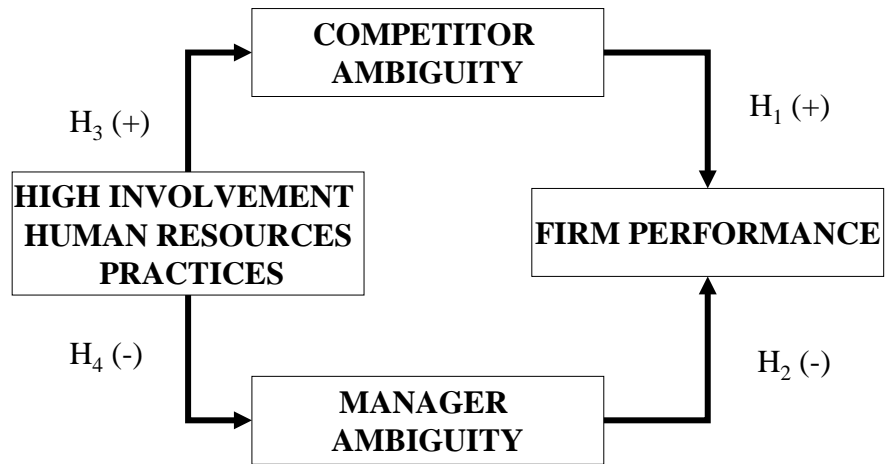


TABLE 1
Factorial Analysis: Types of ambiguity

ÍTEM	COMPONENTS		COMUNALITIES
	1	2	
MA1	0,63	0,01	0,39
MA2	0,55	0,02	0,30
MA3	0,80	-0,03	0,64
MA4	0,82	-0,02	0,68
MA5	0,63	0,07	0,40
MA6	0,74	-0,06	0,56
CA1	-0,04	0,66	0,45
CA2	0,05	0,76	0,58
CA3	0,12	0,67	0,46
CA4	-0,12	0,73	0,55
% of variance accounted for	30,07	20,21	
Eigenvalue	3,007	2,02	

TABLE 2
Factorial Analysis: Human resource practices

ITEM ¹	COMPONENTS							COM
	1	2	3	4	5	6	7	
SEL1	0,153	0,472	-0,040	0,233	0,626	0,160	-0,052	0,72
SEL2	0,116	0,500	-0,040	0,167	0,575	0,218	-0,001	0,67
SEL3	0,170	0,170	-0,009	0,101	0,744	-0,030	-0,082	0,63
SEL4	0,068	0,046	0,110	0,199	0,795	0,072	0,128	0,71
TRN1	0,178	0,705	0,257	0,204	0,207	-0,018	0,142	0,70
TRN2	0,183	0,701	0,324	0,053	0,278	0,005	0,186	0,74
TRN3	0,240	0,608	0,409	0,121	0,145	0,010	0,111	0,64
TRN4	0,365	0,598	-0,114	0,244	-0,058	-0,040	-0,054	0,57
COMP1	0,101	0,048	0,154	0,695	0,303	0,071	-0,108	0,63
COMP2	0,033	0,122	-0,016	0,818	0,180	0,078	0,040	0,72
COMP3	0,271	0,030	0,161	0,649	0,018	0,008	0,092	0,53
COMP4	0,216	0,165	0,385	0,157	0,087	0,091	-0,427	0,45
COMP5	0,108	-0,118	0,013	0,102	0,071	0,766	0,094	0,64
APPR1	0,189	0,268	0,028	0,683	0,102	0,231	0,075	0,64
APPR2	0,124	0,123	0,205	0,148	0,084	0,741	0,053	0,65
JDSN1	0,118	0,178	0,110	0,196	0,330	0,086	0,616	0,59
JDSN2	0,135	0,045	0,054	0,011	-0,119	0,129	0,739	0,60
MOTI1	0,736	0,035	0,000	0,072	0,140	0,259	0,231	0,69
MOTI2	0,806	0,178	0,120	0,248	0,166	0,140	0,073	0,81
MOTI3	0,738	0,346	0,180	0,176	0,103	0,072	-0,153	0,77
MOTI4	0,503	0,247	0,501	0,302	0,067	0,089	0,023	0,70
OTHS1	0,661	0,214	0,333	0,086	0,184	-0,109	0,225	0,70
OTHS2	0,190	-0,005	0,761	0,020	0,112	-0,017	-0,005	0,63
OTHS3	0,129	0,210	0,780	0,140	-0,072	0,135	-0,009	0,71
OTHS4	0,043	0,380	0,652	-0,051	-0,056	0,140	0,150	0,62
OTHS5	0,631	0,334	0,386	0,111	0,028	0,054	-0,094	0,68
OTHS6	0,136	0,622	0,223	0,000	0,209	-0,031	-0,084	0,51
% of variance	31,86	8,82	6,74	5,30	5,06	4,10	3,40	
Eigenvalue	8,60	2,40	1,82	1,43	1,37	1,11	0,92	

¹ These indicators are those that were used to measure human resource practices. They are shown in appendix 1.

TABLE 3
Mean, Standard Deviations and Correlations

Variable	N	Mean	s.d.	1	2	3	4	5	6
1. Firm performance	236	4,00	1,99						
2. Manager ambiguity	256	0,00	1,00	-0,37***					
3. Competitor ambiguity	256	0,00	1,00	0,14**	0,00				
4. High Involvement HRM	250	0,00	1,00	0,32***	-0,38***	0,08			
5. Firm size ²	253	5,68	1,31	0,06	-0,11	-0,17***	0,12**		
6. Firm age ²	258	3,50	0,72	-0,07	-0,06	-0,04	-0,14**	0,18***	
7. CEO longevity ²	248	2,29	1,01	0,14**	-0,08	0,04	0,11	0,08	0,08

**p < 0,05

***p < 0,01

² These data were transformed by logarithm function

TABLE 4
Results of regression analysis for firm performance

Variables	Model 1		Model 2		Model 3	
	b	s.e.	b	s.e.	b	s.e.
Intercept	4,11***	1,24	3,78***	1,23	4,04***	1,14
Firm size	0,15	0,13	0,18	0,12	0,13	0,12
Firm age	-0,25	0,20	-0,26	0,20	-0,31*	0,19
CEO longevity	0,27**	0,13	0,26*	0,13	0,22*	0,12
Sector sic20	-0,52	0,92	-0,29	0,91	-0,01	0,85
Sector sic22	0,53	1,10	0,78	1,09	1,30	1,02
Sector sic23	0,66	1,64	1,22	1,64	0,87	1,52
Sector sic24	-2,74*	1,61	-2,36	1,60	-1,08	1,50
Sector sic26	0,67	1,29	0,89	1,28	1,29	1,19
Sector sic27	-0,67	1,11	-0,39	1,11	-0,68	1,03
Sector sic28	-1,02	0,92	-0,75	0,92	-0,55	0,85
Sector sic29	-0,15	2,12	0,37	2,10	0,61	1,95
Sector sic30	-1,32	1,06	-1,24	1,04	-0,99	0,97
Sector sic31	0,17	1,63	0,54	1,62	1,09	1,50
Sector sic32	-0,70	0,98	-0,49	0,98	-0,15	0,91
Sector sic33	-2,13*	1,08	-1,84*	1,08	-1,29	1,00
Sector sic34	-0,31	1,02	0,03	1,01	0,32	0,94
Sector sic35	-0,29	0,95	-0,12	0,94	-0,07	0,88
Sector sic36	-1,10	0,97	-1,02	0,96	-0,69	0,90
Sector sic37	-1,08	0,97	-0,95	0,96	-0,60	0,89
Sector sic38	-0,26	1,17	-0,16	1,16	-0,28	1,07
Competitor Ambiguity			0,33**	0,14	0,35***	0,13
Manager Ambiguity					-0,77***	0,13
R ²	0,12		0,14		0,27	
F	1,33		1,56*		3,28***	
N	258		258		258	

*p < 0,10

**p < 0,05

***p < 0,01

TABLE 5
Results of regression analysis for competitor ambiguity

Variables	Model 1		Model 2	
	b	s.e.	b	s.e
Intercept	1,37**	0,63	1,21*	0,63
Firm size	-0,14**	0,06	-0,15	0,06
Firm age	-0,01	0,10	0,02	0,10
CEO longevity	0,04	0,07	0,02	0,07
Sector sic20	-0,72	0,48	-0,84	0,48
Sector sic22	-0,84	0,61	-0,98	0,61
Sector sic23	-1,62**	0,85	-1,65	0,85
Sector sic24	-1,19	0,84	-1,31	0,84
Sector sic26	-0,75	0,63	-0,83	0,63
Sector sic27	-0,83	0,58	-1,06	0,59
Sector sic28	-0,84*	0,48	-0,98	0,49
Sector sic29	-1,54	1,10	-1,83	1,11
Sector sic30	-0,38	0,55	-0,49	0,55
Sector sic31	-1,07	0,84	-1,12	0,84
Sector sic32	-0,54	0,50	-0,62	0,50
Sector sic33	-0,63	0,56	-0,66	0,56
Sector sic34	-1,03**	0,52	-1,18	0,53
Sector sic35	-0,46	0,49	-0,64	0,51
Sector sic36	0,21	0,50	-0,35	0,51
Sector sic37	0,48	0,49	-0,62	0,50
Sector sic38	-0,26	0,61	-0,44	0,62
High Involvement HR practices			0,08	0,05
R ²	0,10		0,11	
F	1,14		1,21	
N	258		258	

*p < 0,10

**p < 0,05

TABLE 6
Results of regression analysis for manager ambiguity

Variables	Model 1		Model 2	
	b	s.e.	b	s.e
Intercept	0,36	0,62	0,90	0,58
Firm size	-0,10	0,06	-0,04	0,05
Firm age	0,02	0,09	-0,03	0,09
CEO longevity	-0,10	0,07	0,77	0,06
Sector sic20	0,31	0,47	1,35	0,47
Sector sic22	0,84	0,60	-0,30	0,55
Sector sic23	-0,40	0,84	2,07	0,77
Sector sic24	1,65**	0,82	0,61	0,76
Sector sic26	0,44	0,62	0,73	0,57
Sector sic27	-0,50	0,57	0,37	0,54
Sector sic28	0,33	0,47	0,83	0,44
Sector sic29	0,32	1,08	1,37	1,01
Sector sic30	0,54	0,54	0,95	0,50
Sector sic31	0,56	0,83	0,74	0,76
Sector sic32	0,40	0,49	0,71	0,45
Sector sic33	0,73	0,55	0,86	0,51
Sector sic34	0,31	0,51	0,83	0,48
Sector sic35	-0,01	0,48	0,59	0,46
Sector sic36	0,43	0,49	0,94	0,46
Sector sic37	0,43	0,48	0,92	0,45
Sector sic38	-0,19	0,60	0,45	0,56
High Involvement HR practices			-0,28***	0,04
R ²	0,10		0,24	
F	1,23		3,25***	
N	258		258	

**p < 0,05

***p < 0,01

TABLE 6
Results of regression analysis for manager ambiguity

Variables	Model 1		Model 2	
	b	s.e.	b	s.e
Intercept	0,36	0,62	0,90	0,58
Firm size	-0,10	0,06	-0,04	0,05
Firm age	0,02	0,09	-0,03	0,09
CEO longevity	-0,10	0,07	0,77	0,06
Sector sic20	0,31	0,47	1,35	0,47
Sector sic22	0,84	0,60	-0,30	0,55
Sector sic23	-0,40	0,84	2,07	0,77
Sector sic24	1,65**	0,82	0,61	0,76
Sector sic26	0,44	0,62	0,73	0,57
Sector sic27	-0,50	0,57	0,37	0,54
Sector sic28	0,33	0,47	0,83	0,44
Sector sic29	0,32	1,08	1,37	1,01
Sector sic30	0,54	0,54	0,95	0,50
Sector sic31	0,56	0,83	0,74	0,76
Sector sic32	0,40	0,49	0,71	0,45
Sector sic33	0,73	0,55	0,86	0,51
Sector sic34	0,31	0,51	0,83	0,48
Sector sic35	-0,01	0,48	0,59	0,46
Sector sic36	0,43	0,49	0,94	0,46
Sector sic37	0,43	0,48	0,92	0,45
Sector sic38	-0,19	0,60	0,45	0,56
High Involvement humar resource practices			-0,28***	0,04
R ²	0,10		0,24	
F	1,23		3,25***	
N	258		258	

**p < 0,05

***p < 0,01

TABLE 7
Models for testing mediation effect

Variables	Model 1		Model 2	
	b	s.e.	b	s.e.
High Involvement HR practices	0,46***	0,09	0,24***	0,10
Manager Ambiguity			-0,67***	0,14
R ²	0,21		0,30	
F	2,50***		3,89***	
N	258		258	

*p < 0,10

**p < 0,05

***p < 0,01